Chapter 6

NASA's International Relations in Space

An Historical Overview

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"That's one small step for man, one giant leap for mankind." These "eternally famous words," as James Hansen calls them in his biography of Neil Armstrong, expressed both a NASA and an American triumph.[1] They also reached out to the millions watching the spectacle on television screens all over the world, allowing them to make it their own. Elevating the particular to the universal, Armstrong suggested that the awesome technological power embodied in the Moon landing, while indicative of American supremacy, was also a resource that would benefit all—a promise, not a threat. About 30 minutes into the mission, shortly after having been joined by Edwin "Buzz" Aldrin, Armstrong read the words on a plaque attached to one of the ladder legs of the Lunar Module. The *Eagle*—a name deliberately chosen by the astronauts as the symbol of America—had no territorial ambitions: as Armstrong said, "We came in peace for all mankind."[2] "For one priceless moment in the history of man," Nixon told the astronauts as they explored the lunar surface, "all the people on this earth are truly one"—one, that was, under the benevolent American flag that had been erected with some difficulty a few minutes earlier.[3]

The spectacles of the Moon landing and the moonwalk are suffused with quintessentially American tropes: white, athletic males burst the grip of gravity

1. James R. Hansen, *First Man: The Life of Neil A. Armstrong* (New York, NY: Simon & Schuster, 2005), p. 493.
2. Ibid., pp. 393, 503.
3. Ibid., p. 505.

to conquer a new frontier.[4] America's technological superiority in the service of global expansion is affirmed. Feelings of national pride mingle with arrogance, "an arrogance," as Aldrin put it, "inspired by knowing that so many people had worked on this landing, people possessing the greatest scientific talents in the world."[5] The vitality of a dynamic capitalist society imbued with Christian values—Aldrin took Communion soon after the *Eagle* landed on the Moon—is affirmed against the suffocating state socialism of godless communism.[6]

The coupling of national prowess with global leadership was deliberate. For Willis Shapley, Associate Deputy Administrator at NASA Headquarters, the mission would show the world that "the first lunar landing [is] an historic step forward for all mankind that has been accomplished by the United States of America."[7] All the same, we should not be overwhelmed by the political and ideological staging of Apollo 11 as an American-led achievement of transcendent meaning. For the mission also had genuine international components. As everybody knows, beginning with Apollo 11, NASA astronauts collected over 840 pounds of Moon rock and distributed hundreds of samples for public viewing and scientific research all over the world.[8] Less well-known is the fact that the first video images of Armstrong's and Aldrin's steps on the Moon were picked up not in the United States, but by antennas at Honeysuckle Creek and the Parkes Observatory near Canberra in Australia, a tribute to the vast global data and tracking network that supports NASA's missions.[9] Even more pertinent for this article, one of the few scientific experiments conducted on the lunar surface during Armstrong and Aldrin's 160-odd minutes of surface activity on the night of 20 July 1969 had a foreign Principal Investigator.

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4. For survey of the historical literature, see Roger D. Launius, "Interpreting the Moon Landings: Project Apollo and the Historians," *History and Technology* 22, no. 3 (September 2006): 225–255. On the gendering of the Apollo program, see Margaret A. Weitekamp, *The Right Stuff, the Wrong Sex: The Lovelace Women in the Space Program* (Baltimore, MD: Johns Hopkins University Press, 2004); Margaret A. Weitekamp, "The 'Astronautrix' and the 'Magnificent Male': Jerrie Cobb's Quest to be the First Woman in America's Manned Space Program," in *Impossible to Hold: Women and Culture in the 1960s*, ed. Avital H. Bloch and Lauri Umansky (New York, NY: New York University Press), pp. 9–28.
5. Edwin E. "Buzz" Aldrin (with Wayne Warga), *Return to Earth* (New York, NY: Random House, 1973), p. 231. This feeling was bolstered by the successful management of a last-minute alarm by the astronauts and ground control at Houston as Armstrong and Aldrin were just 6,000 feet above the lunar surface. See also David Mindell, *Digital Apollo: Human and Machine in Spaceflight* (Cambridge, MA: MIT Press, 2008).
6. On the Communion, see Aldrin, *Return to Earth*, pp. 232–233.
7. Quoted by Hansen, *First Man*, p. 495.
8. Ibid., pp. 513–514.
9. Sunny Tsiao, *"Read You Loud and Clear!" The Story of NASA's Spaceflight Tracking and Data Network* (Washington, DC: NASA SP-2007-4232), chap. 5.

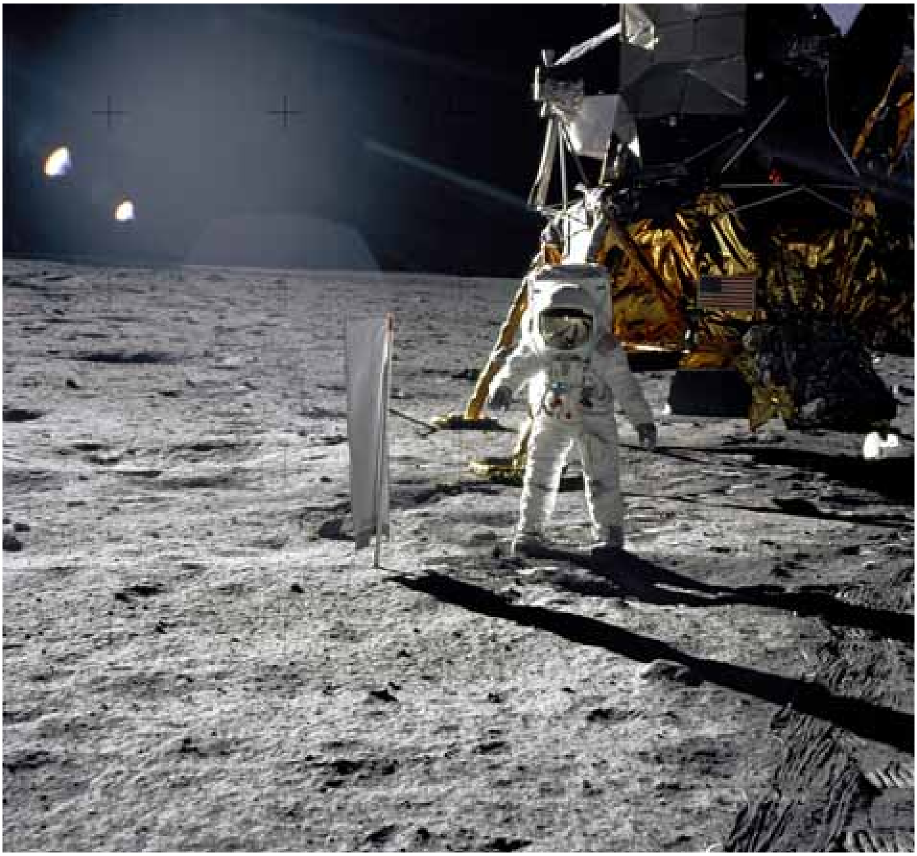

Figure 1: Astronaut Edwin E. "Buzz" Aldrin, Jr., Lunar Module pilot during the Apollo 11 extravehicular activity (EVA) on the lunar surface. In the right background is the Lunar Module Eagle. On Aldrin's right is the Solar Wind Composition Experiment already deployed. This photograph was taken by Neil A. Armstrong with a 70-millimeter lunar surface camera. *NASA Image AS11-40-5873*

During their brief sojourn on the Moon the astronauts engaged in six scientific experiments, all chosen by a NASA scientific panel for their interest and excellence. Five of these were part of the Early Apollo Scientific Experiment Package. They included a passive seismometer to analyze lunar structure and detect moonquakes, as well as a device to measure precisely the distance between the Moon and Earth. The sixth was an independent Solar Wind Composition Experiment. To perform this experiment the astronauts had to unroll a banner of thin aluminum metal foil about 12 inches wide by 55 inches long and orient one side of it toward the Sun. The foil trapped the ions of rare gases emitted from the Sun. It was brought back to Earth in a Teflon bag, cleaned ultrasonically, and melted in an ultrahigh vacuum, releasing the gases that were then analyzed in a mass spectrometer.[10] The results provided insights into the dynamics of the solar wind, the origin of the solar system, and the history of planetary atmospheres.

Johannes Geiss, a leading Swiss scientist, was responsible for this experiment. The payload was manufactured at Geiss's University of Bern and was paid for by the Swiss National Science Foundation.[11] What is more, apart from Armstrong's contingency collection of lunar samples immediately on emerging from the Lunar Module, this was the first experiment deployed by the astronauts. Indeed, to ensure that the foil was exposed to the Sun for as long as possible, it was even deployed *before* Armstrong and Aldrin planted the American flag in the lunar surface and spoke to the President. Scientific need trumped political and ideological statement. NASA's commitment to international cooperation could not be expressed by having the flags of many countries, or perhaps just the flag of the United Nations, left on the Moon. Congress decided that this was an American project and that the astronauts would plant the U.S. flag.[12] Instead, NASA's international agenda fused seamlessly with the "universalism" of science to create a niche for flying an experiment built by a university group in a small, neutral European country.

It is striking that even though the Solar Wind Experiment is routinely mentioned in writings on the Apollo 11 mission, the European source of the experiment is not.[13] This is partly because of the iron grip that human space-

10. "Experiment Operations During Apollo EVAs. Experiment: Solar Wind Composition," available at *http://ares.jsc.nasa.gov/humanexplore/exploration/exlibrary/docs/apollocat/part1/swc.htm* (accessed 31 August 2008).
11. Thomas A. Sullivan, *Catalog of Apollo Experiment Operations* (Washington, DC: NASA Reference Publication 1317, 1994), pp. 113–116. Geiss's team also measured the amounts of rare gases trapped in lunar rocks: P. Eberhart, J. Geiss, et al., "Trapped Solar Wind Noble Gases, Exposure Age and K/Ar Age in Apollo 11 Lunar Fine Material" (*Proceedings of the Apollo 11 Lunar Science Conference*, vol. 2, ed. A. A. Levinson, Houston, TX, 5–8 January 1970). See also *Chemical and Isotopic Analysis*, pp. 1037–1070.
12. Hansen, *First Man*, p. 395.
13. This is true of scholarly works like Hansen's *First Man*, chap. 29; accounts specifically concerned with lunar science, like William David Compton's *Where No Man Has Gone Before: A History of Apollo Lunar Exploration Missions* (Washington, DC: NASA SP-4214, 1989); autobiographical accounts like Aldrin's *Return to Earth*, chap. 8; and semipopular works like Leon Wagener's *One Giant Leap: Neil Armstrong's Stellar American Journey* (New York, NY: Forge Books, 2004), chap. 14. None of these sources mentions that the Swiss experiment was deployed before the American flag was unfurled. One has to burrow deep into the official records to extract these data (see *Experiment Operations During Apollo EVAs*). I only did so because I was alerted to the existence of Geiss's experiment by Peter Creola, Swiss and European statesman and space enthusiast: see Peter Creola, interview by John Krige, Bern, Switzerland, 25 May 2007, NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC. For Creola's own role in space, see anon., *Peter Creola: Advocate of Space* (Noordwijk, Netherlands: ESA SP-1265/E, 2002).

flight has on the imagination, a mindset constructed by enthusiasts whose shrill voices and skillful marketing have capitalized on the frontier myth that is deeply ingrained in America's sense of itself and its destiny, so playing down alternative, less glamorous visions of spaceflight using benign technologies.[14] It is the challenges faced by the astronauts as they conquer new domains, not the scientific content of the Apollo missions, that resonate culturally, that entertain and inspire, that showcase American technological success and project American power abroad.

The European contribution to Apollo 11 is also ignored because so much space history in the United States—as everywhere—is nationalistic and celebratory, a symptom of the high value placed on technological achievement as a marker of national prowess. There is no doubt that NASA's achievements are extraordinary and that they dwarf the efforts of other spacefaring nations. To date, these have only been able to match the American space program in select domains (the Soviets in some aspects of human spaceflight, the Europeans with their civilian launchers and dynamic science program, the French with the Satellite Pour l'Observation de la Terre [SPOT] series of Earth observation/reconnaissance satellites, and so on). But even if the United States is the undisputed leader in space science and technology, it should not be forgotten that "leadership" is relative and that the preeminence it expresses is assessed in relation to what others are doing. Those competitors and collaborators help define the terrain on which key social actors strive to maintain American leadership, not to say dominance, of space. The extraordinary national feats repeatedly celebrated by America-centric space history do not only serve domestic imperatives; they also help the United States situate itself vis-à-vis other space powers, and they lay the groundwork and create the capacity for it to try to shape what others do in line with American objectives and interests. The international dimension is thus not peripheral to NASA's mission to maintain America's leadership in space: it is intrinsic to it.

International Collaboration in the 1958 Space Act

The National Aeronautics and Space Act of 1958 was signed into law by President Eisenhower on 29 July 1958.[15] It distinguished between civilian

14. I owe this point to Howard E. McCurdy, *Space and the American Imagination* (Washington, DC: Smithsonian Institution Press, 1997).
15. The Act is available at *http://www.hq.nasa.gov/office/pao/History/spaceact.html* (accessed 27 January 2005).

and defense-oriented aspects of aeronautical and space activities and called for the establishment of a new agency to provide for the former in parallel to DOD and, although this was not specified in the Act, to the CIA and later to a highly secret covert agency, the National Reconnaissance Office (NRO), established in September 1961.[16] The primary mission of the resulting NASA that formally came into being on 1 October 1958 reflected the dynamics of superpower rivalry and the struggle for leadership with the Soviet Union that had propelled it into existence in the wake of the Sputnik shocks the year before. In particular, the Space Act called on the new agency to ensure "the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere" (Sec. 2 (c) 5). In the fiery political rhetoric of the day, this stress on leadership escalated into a demand for domination. In January 1958, Senate Majority Leader Lyndon Johnson claimed that "Control of space means control of the world, far more certainly, far more totally than any control that has ever or could ever be achieved by weapons, or troops of occupation. Whoever gains that ultimate position gains control, total control, over the earth, for purposes of tyranny or for the service of freedom." John F. Kennedy picked up the refrain in his presidential campaign: "Control of space will be decided in the next decade. If the Soviets control space they can control earth, as in past centuries the nation that controlled the seas dominated the continents . . . . We cannot run second in this vital race."[17] NASA's core mission was thus to preserve American leadership in the mastery of space science and technology, to dominate the new frontier that was outer space so as "to insure peace and freedom" as Kennedy put it.

Other countries, above all from the free world, were to be enrolled in this endeavor. To this end, the Space Act included among NASA's missions "Cooperation by the United States with other nations and groups of nations . . ." (Sec. 2 (c) 7). This objective was developed in a short, separate section headed "International Cooperation." Here it was specified that "The Administration, under the foreign policy guidance of the President, may engage in a program of international cooperation in work done pursuant to the Act, and in the

16. Gerald Haines, "The National Reconnaissance Office. Its Origins, Creation and Early Years," in *Eye in the Sky: The Story of the Corona Spy Satellites*, ed. Dwayne A. Day, John M. Logsdon, and Brian Latell (Washington, DC: Smithsonian Institution Press, 1998), pp. 143–156.
17. Both quoted by McCurdy, *Spaceflight*, pp. 75–76.

peaceful application of the results thereof, pursuant to agreements made by the President with the advice and consent of the Senate" (Sec. 205). International collaboration thus went hand in hand with foreign policy: NASA was to be an arm of American diplomacy.

Eisenhower stressed from the outset that this clause was not intended to engage presidential authority for all bilateral or multilateral programs undertaken by NASA. Its aim, rather, was to allow for the rare occasions when cooperation engaged such important questions of foreign policy that it had to be underpinned by international treaties. The *Final Report of the Senate Special Committee on Space and Aeronautics*, dated 11 March 1959, confirmed this interpretation.[18] As a result, as Arnold Frutkin put it, the pace of the cooperative program "was to be faster and its procedures far simpler than would have otherwise been the case." In particular, "NASA's international program was thus immediately distinguished from that of the Atomic Energy Commission which, under its legislation, was required to obtain approval of its international efforts from Congress."[19] The Space Act thus gave NASA considerable latitude to engage in international collaboration as its officers saw fit and to handle the diplomatic dimensions of its policies and practices informally through interagency consultation, above all with the State Department.

The Emphasis on "Peaceful Use"

A commitment to the "peaceful use" of outer space was essential to the successful exploitation of space for civilian scientific and applications programs on both a national and international collaborative level. As Eilene Galloway, who was involved in drafting the Space Act, has put it, the emphasis on peaceful use was intended to preserve space "as a dependable orderly place for beneficial pursuits."[20] It was driven by two main concerns.

First, there was the fear that space would become a military battlefield or provide platforms from which lethal weapons could be launched at targets on

18. On the IGY, see Rip Bulkeley, *The Sputniks Crisis and Early United States Space Policy* (Bloomington, IN: Indiana University Press, 1991); Fae L. Kosmo, "The Genesis of the International Geophysical Year," *Physics Today* (July 2007): 38–43; and Allan Needell, *Science, Cold War and the American State: Lloyd V. Berkner and the Balance of Professional Ideals* (Chur, Switzerland: Harwood Academic Publishers, 2000).
19. Arnold W. Frutkin, *International Cooperation in Space* (Englewood Cliffs, NJ: Prentice Hall, 1965), p. 31.
20. Eilene Galloway, "Organizing the United States Government for Outer Space, 1957–1958," in *Reconsidering Sputnik: Forty Years Since the Soviet Satellite*, ed. Roger Launius, John M. Logsdon, and Robert W. Smith (Amsterdam, Netherlands: Harwood Academic Publishers, 2000), pp. 309–325. See also "The Woman Who Helped Create NASA," available at *http://www.nasa.gov/topics/history/galloway_space_act.html* (accessed 20 September 2008).

Earth. Such bellicose scenarios were widespread in the late 1940s and 1950s.[21] Indeed, Wernher von Braun, the most charismatic and persuasive booster of human spaceflight at the time, went so far as to propose the construction of a multipurpose crewed space station that would serve equally as a platform for further exploration, as a reconnaissance tool, and as a base for firing atomic weapons at hostile nations.[22] The thought that the Soviets might also have such ambitions, and indeed might be ahead of the United States in developing space weapons, galvanized stakeholders in space affairs in the United States to advocate peaceful use as a way to "prevent war and ensure peace in this pristine environment," as Galloway puts it.[23] The call for peaceful use thus served both to project a positive image of the United States and to defuse the threat of Soviet space supremacy.

The second major reason was to protect the freedom for satellites to fly over foreign territory. It is well known that national security, and certainly not a space race with the Soviets, was the main driver of Eisenhower's space policy. He was not against the use of space for science and for robotic exploration, but what he wanted above all was to exploit satellite technology to penetrate behind the wall of secrecy that surrounded the Soviet military buildup. The administration's interest in launching a scientific satellite during the IGY was intended to clear the way for this technological development. The ideology of international scientific collaboration was instrumentalized to establish, by setting a precedent, the principle of the freedom of space, i.e., the right of any space power or organization to send a satellite over the territory of another country without being accused of violating national sovereignty.[24]

Spurred on by these concerns, the United States moved rapidly to set up an international regime forbidding the militarization of space. Lyndon

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21. McCurdy, *Spaceflight.* Major General Bernard Schriever, who played a major role in developing an ICBM for the Air Force, speaking to space enthusiasts in San Diego, CA, in February 1957, remarked that "several decades from now the important battles may not be sea battles or air battles, but space battles, and we should be spending a certain fraction of our national resources to insure that we do not lag in obtaining space supremacy." Quoted by Dwayne A. Day, "Cover Stories and Hidden Agendas: Early American Space and National Security Policy," in *Reconsidering Sputnik*, ed. Launius, Logsdon, and Smith, pp. 161–195.
22. Michael J. Neufeld, "'Space Superiority': Wernher von Braun's Campaign for a Nuclear-Armed Space Station, 1946–1956," *Space Policy* 22 (February 2006): 52–62.
23. Galloway, "Organizing," p. 322.
24. Walter A. McDougall, . . . *The Heavens and the Earth: A Political Economy of the Space Age* (New York, NY: Basic Books, 1985). See also the collection of articles in Launius, Logsdon, and Smith, ed. *Reconsidering Sputnik*, notably the contribution by Dwayne Day, and the special edition of *Quest* 14, no. 4 (2007).

Johnson was invited by President Eisenhower to address the United Nations in November 1958, where he made a stirring plea against unilateral "penetration into space." "Today outer space is free," Johnson said. "It is unscarred by conflict. No nation holds a concession there. It must remain this way." Johnson went on to stress the "orderly course of full cooperation," which, he said, was the only way to avoid "adding a new dimension to warfare" and to "make the substantial contribution yet . . . toward perfecting peace."[25] In the face of considerable Soviet hostility and suspicion, the United States took the lead in establishing an ad hoc Committee on the Peaceful Uses of Outer Space (COPUOS) that became a regular committee of the United Nations General Assembly in December 1959.[26] This body provided the politico-legal framework in which Washington, DC, sought both to permit the ongoing use of satellites for reconnaissance and to outlaw the use of antisatellite weapons. It faced an uphill struggle.[27] The Soviets were stung by the intelligence-gathering capacity of the U-2 spy planes and by the increased potential of satellites to penetrate their closely guarded military secrets. In June 1962, they formally objected to the use of satellites for reconnaissance. They finally dropped their objections in September 1963. Paul Stares explains the timing of this change of attitude as due to three factors: the now-routine use by the Soviets of their Kosmos series of satellites for intelligence gathering, progress with test ban negotiations (in which satellite overflight was a crucial means to verify compliance), and the prospect of successfully banning nuclear and other weapons of mass destruction from space altogether.[28] Indeed, all parties to the negotiations realized what many scientists had been saying all along: that space platforms were no better and considerably worse than Earth-based ballistic missiles for delivering nuclear weapons to terrestrial targets. Recognizing that "neither side could gain a military advantage by placing nuclear weapons in space [the two superpowers] signed a treaty not to do so" in 1967.[29]

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25. Galloway, "Organizing," p. 319.
26. Andrew G. Haley, *Space Law and Government* (New York, NY: Appleton-Century-Crofts, 1963), pp. 313–328.
27. See, for example, Homer E. Newell, *Beyond the Atmosphere: Early Years of Space Science* (Washington, DC: NASA SP-4211, 1975), chap. 18.
28. Paul B. Stares, *The Militarization of Space: U.S. Policy, 1945–1984* (Ithaca, NY: Cornell University Press, 1985), p. 71.
29. McCurdy, *Spaceflight*, p. 68.

No clear definition of "peaceful use" was laid down by COPUOS, nor has one been established since. This is because of the immense importance of military space programs and, above all, the role that intelligence and reconnaissance satellites have played since the dawn of the Space Age. As one scholar notes, from the late 1950s, "the legal position of the United States with respect to the meaning of the phrase 'peaceful uses' became crystallized along lines quite dissimilar to the original rhetoric. The term 'peaceful' in relation to outer space activities was interpreted by the United States to mean 'non-aggressive' rather than 'non-military.'" In international law, this entails that all military uses are permitted and lawful as long as they do not engage the threat or the use of force.[30] No state has formally protested the United States' interpretation of peaceful use (or at least had not by 1990). This interpretation has been essential to the preservation of both international stability and the national security of the space powers.[31] It is now a central plank of the military's expanding reliance on space for technological support in the global war on terror.

The treaty on the peaceful uses of outer space was drawn up simultaneously with the Antarctic Treaty and has a close resemblance to it.[32] By coincidence, a key preparatory meeting, which spawned the Antarctic Treaty, took place in Washington, DC, just three days after the launch of Sputnik. It was convened by Paul C. Daniels of the Department of State and attended by representatives from Britain, Australia, and New Zealand, all of whom had a national stake in the region. The abiding fear among those present was that the Soviet Union would place missile bases in the frozen waste. Daniel's idea was to exploit the IGY to override claims to national sovereignty and instrumentalize scientific cooperation to demilitarize the region. Article I of the ensuing treaty, signed on 1 December 1959, declared that

30. Ivan A. Vlasic, "The Legal Aspects of Peaceful and Non-Peaceful Uses of Outer Space," in *Peaceful and Non-Peaceful Uses of Space: Problems of Definition for the Prevention of an Arms Race*, ed. Bhupendra Jasani (New York, NY: Taylor and Francis, 1991), pp. 37–55. This is the definition of "non-aggressive" as stipulated in Article 2(4) of the United Nations Charter.
31. John Lewis Gaddis, *The Long Peace: Inquiries into the History of the Cold War* (New York, NY: Oxford University Press, 1987), chap. 7.
32. This paragraph owes much to Simone Turchetti, Simon Naylor, Katrina Dean, and Martin Siegert, "On Thick Ice: Scientific Internationalism and Antarctic Affairs, 1957–1980," *History and Technology* 24, no. 4 (December 2008): 351–376. See also Jacob D. Hamblin, "Masters of Landscapes and Seascapes. Scientists at the Strategic Poles During the International Geophysical Year," in *Extremes: Oceanography's Adventures at the Poles*, ed. Keith R. Benson and Helen M. Rozwadowski (Sagamore Beach, MA: Science History Publications, 2007).

Antarctica was to be used for peaceful uses only; it explicitly prohibited any military activity in the area, including the testing of any kind of weapons.[33] The Treaty respected "previously asserted rights of or claims to sovereignty in Antarctica" (Art. IV.1) but still insisted on the "freedom of scientific investigation in Antarctica and cooperation toward that end" (Art. II.1).[34] Harlan Cleveland, Assistant Secretary of State for International Affairs, claimed that this was the best the United States could hope for and indeed better than making a claim to sovereign territory; such a claim was irrelevant, and indeed restricting, given the techno-scientific power of the United States. As he put it in 1965, "For the United States, as the nation with the greatest capability to mount and support scientific investigations in Antarctica, this Treaty was clearly better than limiting ourselves to one slice of a much-divided pie. As things stand, we are at liberty to investigate anywhere, build anywhere, fly anywhere, traverse anywhere in this vast still mysterious south land."[35] The same logic informed the Space Act's insistence on restricting space to peaceful uses. Claims to national sovereignty were eclipsed by the demand that space be open to all for nonaggressive activities, from science to applications—like telecommunications and meteorology—to intelligence gathering. By avoiding any unambiguous definition of peaceful use, and by roundly rejecting early Soviet demands in COPUOS that reconnaissance satellites be banned from outer space, the United States preserved the possibilities for international collaboration in civilian space projects without impeding the exploitation of space for national defense.

The Scope of International Collaboration

The scope of NASA's international collaboration is truly vast. In 1970, when many countries only had embryonic programs of their own, Arnold Frutkin reported that NASA had already collaborated with scientists in 70 different countries and established 225 interagency or executive agreements with 35 countries.[36] Addressing a congressional subcommittee in 1981, Ken Pedersen remarked that NASA had over 1,000 agreements with 100 countries and that its international programs had resulted in more than $2 billion of economic

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33. Vlasic, "The Legal Aspects," p. 43.
34. The Treaty is reproduced in Haley, *Space Law*, appendix I-A.
35. Turchetti et al., "On Thick Ice," 359–360.
36. Arnold Frutkin, "International Collaboration in Space," *Science* 169, no. 3943 (24 July 1970): 333–339.

benefits for the country.[37] In 2005, Roger Launius remarked that NASA had concluded over 2,000 cooperative agreements with other nations for a multitude of various international space activities.[38] In sum, the number of international agreements entered into by NASA ran at an average of 20 per year during its first decade, exploded to a total 1,000 by the end of its second decade, and then doubled again over the next 20 to 25 years. Looking just at scientific collaboration with Europe, we find that it has increased rapidly in recent times. Launius reported that there had been 139 cooperative science agreements with European nations between 1962 and 1997. Twenty years earlier, John Logsdon counted just 33 projects between 1958 and 1983, suggesting an increase by a factor of four or five in the last decades of the 20th century.[39]

Numbers alone cannot capture this vast enterprise. Table 1 surveys the range of international activities that NASA was engaged in for the first 26 years of its existence. These include infrastructural components like tracking and data acquisition and launch provision. They cover collaboration in science using balloons, sounding rockets and satellites, and applications in areas like remote sensing, communications, and meteorology. In addition, NASA sponsored a huge education and training program through fellowships, research associateships, and the hosting of foreign visitors. There is no doubt that the Agency has played a fundamental role in encouraging and strengthening the exploration and exploitation of space throughout the world, or at least among friendly nations. NASA has helped many countries kick-start their space programs and has enriched them once they had found their own feet. More than that, it has helped give thousands of people in over 100 nations some stake in space, some sense of contributing, albeit in perhaps a small way, to the challenges, opportunities, excitement, and dangers that the conquest of space inspires.

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37. Kenneth S. Pedersen, *Statement to Subcommittee on Science, Technology and Space*; *Committee on Commerce, Science and Transportation*; *United States Senate, 97th Congress*, 31 March 1981, Record No. 1669, folder Pedersen, Kenneth S., NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.
38. Roger D. Launius, "NASA and the Attitude of the U.S. Toward International Space Cooperation," in *Les relations franco-américains dans le domaine spatial (1957–1975): Quatrième recontre de l'IFHE, 8–9 décembre 2005* (Paris, France: IFHE Publications, in press), pp. 45–63.
39. John Logsdon, "U.S.-European Cooperation in Space Science: A 25-Year Perspective," *Science* 223, no. 4631 (6 January 1984): 11–16.

Table 1. Cumulative Statistical Summary Through 1 January 1984[40]

Type of Arrangement	A	B
COOPERATIVE ARRANGEMENTS		
Cooperative Spacecraft Projects	8	38
Experiments on NASA Missions		
Experiments with Foreign Principal Investigators	14	73
U.S. Experiments with Foreign Co-investigators or Team Members	11	56
U.S. Experiments on Foreign Spacecraft	3	14
Cooperative Sounding Rocket Projects	22	1,774[a]
Joint Development Projects	5	9
Cooperative Ground-Based Projects		
Remote Sensing	53	163
Communication Satellite	51[b]	19
Meteorological Satellite	44[c]	11
Geodynamics	43	20
Space Plasma	38	10
Atmospheric Study	14	11
Support of Manned Space Flights	21	2
Solar System Exploration	8	10
Solar Terrestrial and Astrophysics	25	11
Cooperative Balloons and Airborne Projects		
Balloon Flights	9	14
Airborne Observations	12	17
International Solar Energy Projects	24	9
Cooperative Aeronautical Projects	5	40
U.S./USSR Coordinated Space Projects	1	9
U.S./China Space Projects	1	5
Scientific and Technical Information Exchanges	70	3
REIMBURSABLE LAUNCHINGS		
Launchings of non-U.S. Spacecraft	15	95
Foreign Launchings of NASA Spacecraft	1	4
TRACKING AND DATA ACQUISITION		
NASA Overseas Tracking Stations/Facilities	20	48

40. Anon., *26 Years of NASA International Programs* (Washington, DC: NASA, n.d.), p. 3. Thanks to Dick Barnes for providing me with a copy of this booklet.

NASA Funded Smithsonian Astrophysical Observatory (SAO) Optical and Laser Tracking Facilities	16	21
REIMBURSABLE TRACKING ARRANGEMENTS		
Support Provided by NASA	5	48
Support Received by NASA	3	12
PERSONNEL EXCHANGES		
Resident Research Associateships	43	1,417
International Fellowships		358
Technical Training	5	985
Foreign Visitors	131	85,177

A: Number of Countries/International Organizations
B: Number of Projects/Investigations/Actions Completed or in Progress as of 1 January 1984
[a] Number of Actual Launches
[b] United States Agency for International Development Sponsored International Applications Demonstration
[c] Automatic Picture Transmission Stations

The Institutional Dimension

NASA's collaborative effort was originally located institutionally in the Office of International Programs. The first Director, Henry E. Billingsley, was quickly replaced by Arnold W. Frutkin in September 1959. Frutkin joined NASA from the National Academy of Sciences. There, he had been the deputy director of the U.S. National Committee for the IGY and had also served as an adviser to the Academy's delegate to the first and second meetings of the International Committee on Space Research (COSPAR). It was at the second COSPAR meeting in March 1959 that the United States representative, Richard Porter, announced that NASA would be willing to fly single experiments from foreign countries as part of larger payloads on American satellites, as well as to launch complete payloads prepared by other countries.[41] This initiative played a major role in stimulating space research with satellites all over the world.

Frutkin's career at NASA, which lasted 20 years, was crowned with many national and international awards. His many notable achievements included the meteorological and Earth resources satellite data reception networks; the advanced technology satellite regional broadcast experiments, including a highly successful educational program in India; the joint U.S.-Soviet Apollo-Soyuz mission; and the Spacelab agreement signed with the European Space Agency

41. Newell, *Beyond the Atmosphere*, chap. 9. The text of the offer is reproduced in H. Massey and M. O. Robins, *History of British Space Science* (Cambridge, U.K.: Cambridge University Press, 1986), Annex 4.

(ESA). Frutkin also served regularly on United States delegations to the United Nations and other international bodies. In short, in the formative years of the space programs, both in the United States and abroad, Frutkin was, as his official biography put it, "personally responsible for an extraordinary successful series of major international space endeavors contributing equally to the nation's foreign policy objectives and to the advancement of human knowledge" as well as to the "prestige the United States space program enjoys today around the world."[42] In 1978, NASA Administrator Robert Frosch appointed Frutkin Deputy Associate Administrator, then Associate Administrator for External Relations. There, he was responsible for the development of external policy with the public, the international community, universities, and local and state governments, as well as DOD and other federal agencies. The post was not to his liking, and Frutkin left government service shortly thereafter in June 1979.[43] Frutkin's activities were taken over by Kenneth Pedersen, Director of the International Affairs Division of the Office of External Relations. Pedersen had been an assistant professor of political science at San Diego State University from 1968 to 1971, before taking on various policy analysis activities in the federal government. Prior to moving to NASA, he had worked for the Nuclear Regulatory Commission that had replaced the AEC in 1975. Pedersen was the director of the Office of Policy Evaluation that dealt with all aspects of nuclear regulation. He also worked closely with the International Atomic Energy Agency in Vienna, Austria.

Frutkin laid down the basic principles that guided NASA's international collaborative projects for two decades in which the United States was the leading space power in the free world. Pedersen frequently remarked that he was dealing with a different geopolitical situation in which the United States' historical rival for space superiority, the Soviet Union, was showing a greater willingness to open out to international partners and in which the space programs in other regions and countries, notably Western Europe and Japan, had matured significantly. The new, neoliberal philosophy of President Reagan also laid greater stress on rolling back the state's engagement in the provision of space technology (notably launchers); private industry

42. NASA Release No. 59-210, 3 September 1959; NASA Key Personnel Change, 1 June 1979, Record No. 726, folder 11.2.1, Frutkin, Arnold W., NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.
43. NASA Key Personnel Change, 1 June 1979.

was encouraged to exploit the economic potential of space.[44] Pedersen's programmatic statements stressed the need for NASA to accept these new realities and to adjust its attitudes to collaboration to reflect the fact that its budgets were limited and that it was no longer "the only game in town." In September 1985, Pedersen was named Deputy Associate Administrator for External Relations and was elevated to Associate Administrator three years later in November 1988.[45]

Richard Barnes replaced Ken Pedersen as Director of International Affairs in 1985.[46] Barnes had been with NASA since 1961 after serving with the AEC's Division of International Affairs and being affiliated with the Atomic Industrial Forum. Barnes was Frutkin's right-hand man during the 1960s and 1970s, before moving on to become NASA's European Representative. He was based at the American Embassy in Paris in the early 1980s, a period and a personality fondly remembered by many Europeans who had dealings with him.

During his term of office, Pedersen had taken a year's sabbatical at Georgetown University. In August 1990, Margaret "Peggy" Finarelli took over his duties when he moved definitively into academia; she was elevated to Pedersen's post of Associate Administrator for External Relations in January 1991. Finarelli joined NASA in 1981 after serving in various government agencies including the White House Office of Science and Technology Policy; she also served as a technical adviser at the Arms Control and Disarmament Agency. She was NASA's chief negotiator for the international agreements with Canada, Europe, and Japan regarding cooperation in the Space Station *Freedom* program.[47]

In October 1991, NASA Administrator Richard Truly reorganized NASA's external relations. He created a new Office of Policy Coordination and International Relations at Headquarters to enable NASA, as he put it, "to respond effectively to the growing international and interagency policy aspects of America's civil space and aeronautics activities."[48] It had four divi-

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44. For one example of this policy and its exaggerated hopes, see John Krige, "The Commercial Challenge to Arianespace. The TCI Affair," *Space Policy* 15, no. 2 (May 1999): 87–94.
45. Special Announcement, 1 February 1979; Release 88-160, 21 November 1988, Record No. 1669, folder Pedersen, Kenneth S., NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.
46. Release 85-132, 20 September 1985, Record No. 000137, folder Barnes, Richard J. H., NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.
47. Release 90-7, 2 August 1990; Release 91-3, 7 January 1991, Record No. 1669, folder Pedersen, Kenneth S., NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.
48. Special Announcement, 3 October 1991, Record No. 640, folder Finarelli, Margaret, NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.

sions. The International Relations Division was led by Peter G. Smith. Smith joined NASA in 1979 as China Desk Officer after a distinguished career in the State Department. His division was institutionally situated alongside the Policy Coordination Division, the Defense Affairs Division, and the Office of National Service. Finarelli was appointed Associate Administrator of the umbrella office. John D. Schumacher, who had joined NASA in 1989 from a New York law firm, was appointed her deputy. In 1995 NASA Administrator Daniel Goldin appointed Schumacher to the post of Associate Administrator for the Office of External Relations, citing his extensive managerial experience and talent to head an office that was dedicated to "international policy formulation, coordination and implementation."[49]

Three points emerge from this brief survey of the organization of international relations inside NASA from the late 1950s to the early 1990s. First, only Frutkin was directly involved in space matters before he joined NASA, notably through his important role in the National Academy of Sciences and the IGY. Second, the officers appointed to these posts had gained extensive international experience though immersion in nuclear matters, either through the civil nuclear energy program (Barnes, Pedersen) or through arms control (Finarelli). Finally, we see a marked shift in profile, beginning with Pedersen, toward people with formal experience in policy formulation and legal affairs. This change is reflected in NASA Administrator Truly's reorganization in the early 1990s, which elevated Finarelli and Schumacher to senior positions in a new office at Headquarters and which placed Smith at the head of the International Relations Division. It is confirmed with the subsequent promotion of Schumacher to head the Office of External Relations. As NASA and its international relations and obligations expanded, as the programs grew in size and in complexity, and as national security agendas promoted the use of antisatellite weapons in space (along with increasing fears of technology transfer), the rather autonomous approach that had marked Frutkin's 20 years in office inevitably yielded to a more formal mechanism for managing the Agency's relations with its domestic and international partners, from policy formulation to implementation.

Frutkin's Guidelines for International Collaboration

There were two original stimuli for international collaboration; both of them were referred to in the episode described at the start of this article, and they

49. News release 95-102, 26 June 1995, Record No. 2955, folder Schumacher, John D., NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.

are illustrated in table 1. Firstly, there was the wish, inspired by major international initiatives like the IGY and the exploration of Antarctica, and coherent with an abiding thread in American foreign policy, to engage other countries (especially friendly and neutral countries) in an exciting new scientific and technological adventure where they could benefit from American leadership and largesse.[50] Secondly, there was the practical need for a worldwide tracking and data-handling network to monitor and intervene in NASA's multiple space missions from planetary probes to human exploration. Sunny Tsiao has recently covered the latter dimension in depth.[51] Here I will concentrate on the scientific and technological aspects of international collaboration in scientific and applications satellites and in human spaceflight from the creation of NASA up to the late 1990s.

In 1965, Arnold Frutkin published an important book spelling out the philosophy that he thought should underpin international cooperation in space.[52] It insisted on the need for "A program founded on conservative values, though not necessarily conservative in scope and objectives . . . ."[53] This view was deeply embedded in Frutkin's thinking. It was probably inspired by the emphasis (in the congressional committee hearings that led to the creation of NASA) that international collaboration in space could transform the tense and confrontational international political climate of the day into one of peaceful coexistence. As Don Kash pointed out 40 years ago, this sentiment led Frutkin to stress the differences between the reality of NASA's programs and the broad hopes expressed in Congress and by three Presidents that international space collaboration would create a new political reality.[54] Insisting that space collaboration could not upset the political status quo, Frutkin advised the State Department in February 1959 that "Political commitments regarding

50. Marcia S. Smith, "America's International Space Activities," *Society* 21, no. 2 (January/February 1984): 18–25.
51. Tsiao, "Read You Loud and Clear!" For a review, see *NASA News and Notes* 25, no. 3 (August 2008): 1–5. The system comprised four tracking programs: Minitrack, a north-south network through the Western Hemisphere for scientific satellites; the Deep Space Network; the manned spaceflight ground stations; and the Baker-Nunn tracking stations for a Smithsonian astrophysics program. For an account of the last, see Teasel Muir-Harmony, "Tracking Diplomacy: The IGY and American Scientific and Technical Exchange with East Asia, 1955–1973," in *Making Science Global: Reconsidering the Social and Intellectual Implications of the International Polar and Geophysical Years* (proceedings), chap. 16.
52. Frutkin, *International Cooperation in Space*.
53. Ibid., p. 32.
54. Don E. Kash, *The Politics of Space Cooperation* (West Lafayette, IN: Purdue University Press, 1967), p. 126.

U.S. performance or accomplishment in international space matters should be made with the very greatest caution and conservatism."[55]

This is why one of Frutkin's chief concerns in the early 1960s was to puncture the bubble of enthusiasm and misguided optimism surrounding the achievements of the IGY. This huge enterprise, which combined the efforts of as many 60,000 scientists and technicians from about 66 nations in a study of Earth and the upper atmosphere, was rapidly assuming the stature of a myth; its significance was amplified by exaggerated claims made for the possibilities of international scientific cooperation as an instrument to bring governments together. Frutkin deplored both tendencies. The IGY, he noted, was not a unified and integrated program of cooperation between governments. It was a collection of national programs independently working toward purely scientific objectives that were loosely coordinated by a nongovernmental mechanism. Yes, the IGY had built "scientific bridges across political chasms," "but the bridges had no effect on the chasms; these remained and no traffic other than scientific passed between them." As for scientists, his experience had taught him that they were "demonstrably subject to normal, human limitations and nationalist constraints," just like everyone else. Notwithstanding their rhetoric, they had no privileged ability to overcome national rivalry. They cooperated across borders because in some disciplines, including those connected with space, worldwide collaboration was essential if knowledge was to progress. Science was also of "critical value for cooperation because of the critical dangers with which it is associated," typically in the atom and in space, but also in a field like meteorology, where international collaboration was stimulated by the prospect of weather modification. In short, Frutkin was emphatic that in defining policy, one had to discard "sentiment and tenuous history" that misrepresented and exaggerated the possibilities for bringing about closer collaboration between peoples through international space cooperation.[56]

The one-sided emphasis on scientific cooperation as an innovative instrument to reduce global tensions masked the political competition that was intrinsic to the conquest of space. Essential space technologies, wrote Frutkin, "—rockets, radio, guidance, stabilization—were all common to both the military

55. These sentiments are expressed in a NASA and National Academy of Sciences "Advisory Paper for the Department of State on International Cooperation in Space Activities," dated 12 February 1959, p. 12. It was sent by Hugh Odishaw to Homer Newell, and it was intended to guide United States policy in the United Nations. An annotated footnote suggests that Frutkin actually wrote it. I am grateful to John Logsdon for providing me with a copy of this document.
56. Frutkin, *International Cooperation*, p. 19 on the IGY, p. 15 on scientific cooperation.

and to science." Even the scientific results of space research, from a better understanding of the weather to a more precise knowledge of Earth's shape and its magnetic field, straddled the civilian/military divide. Space achievements were also exploited for propaganda purposes in the context of the Cold War, being used to win the battle for people's admiration and allegiance in the politically uncommitted parts of the world.[57] In short, space exploration was necessarily politicized and suffused with national security concerns that were broadly conceived. Quoting NASA Administrator James Webb, Frutkin remarked that space, like Janus, looked in two directions: one emphasizing international cooperation and the other emphasizing international competition.[58] Frutkin did not deny that any international project would have political implications and that these "should serve the political interests of the United States." However, he was convinced that to avoid criticism, "political objectives are best served by solid accomplishment which may then be exploited politically *after the fact*."[59]

In his book published in 1965, Frutkin identified a number of criteria for a successful international collaborative project. Twenty years later, they were presented more or less unchanged as the basic guidelines for NASA's relationship with its partners.[60] In this summary form, they read:

- Designation by each participating government of a government agency for the negotiation and supervision of joint efforts.
- Conduct of projects and activities having scientific validity and mutual interest.
- Agreement upon specific projects rather than generalized programs.
- Acceptance of financial responsibility by each participating agency for its own contributions to joint projects.
- Provision for the widest and most practicable dissemination of the results of cooperative projects.

This list requires some elaboration.

The first requirement was that NASA have just one interlocutor to deal with in the partner country, an interlocutor that had official authority to engage the human, financial, and industrial resources in the collaborative project. Frutkin was aware that at the dawn of the Space Age, many individuals, pressure groups,

57. Ibid., p. 5.
58. Ibid., p. 8.
59. NASA and National Academy of Sciences "Advisory Paper," p. 1, emphasis in the original.
60. In the introduction to *26 Years of NASA International Programs*, signed by the International Affairs Division, then headed by Ken Pedersen, who also wrote the foreword to the booklet.

and government departments would be jockeying for control of the civilian space program, as they had in the United States. He wanted NASA to avoid becoming enrolled in these domestic conflicts or, indeed, unwittingly being used to promote the interests of one party over the other, hence his refusal to negotiate with anyone but a single official representative. This policy, coupled with NASA's offer to fly foreign payloads in March 1959, not only stimulated the creation of space programs in foreign countries; it forced the national authorities to designate one body as responsible for international collaboration and, in some cases, led to the rapid establishment of a national or regional space agency. Whereas Frutkin originally left the door open for collaborating with "a central, civilian, and government sponsored, if not governmental authority," by 1986 space agencies were so widespread internationally that NASA could simply designate them as its preferred partners.[61]

The second criterion was obviously meant to make scientific exploration, not political exploitation, the core of any collaborative space program. This was consistent with Frutkin's determination to distinguish the technical from the political and make the former the driving force of the effort. At the same time, he was sensitive to the asymmetry in space capability between NASA and any potential partner in the 1960s, the Soviet Union excepted. He did not want the United States to use its advantage to dictate what others did, both so as to encourage local communities to formulate their own programs and to avoid later charges that the United States had "dominated" the space activities of its partners. Hence his demand that each country "poll its scientific community for relevant ideas" and, in consultation with NASA, "develop full-fledged proposals for cooperative experiments having a character of their own."[62]

This concern also informed the criterion that all agreements should be on a project-by-project basis. An open-ended engagement to collaborate could lead to NASA's committing itself to costly projects that were of no interest to United States investigators. By evaluating each proposal on a case-by-case basis, it could be assessed for its novelty and compatibility with the general thrust of the American space effort, so contributing to the knowledge base of both partners. Also for that reason, both would be willing to invest resources in their part of the project without seeking help from the other. This clause, summarized by the slogan "no exchange of funds," was a cornerstone of

61. Frutkin, *International Cooperation*, p. 34.
62. Ibid., p. 35.

NASA policy and a touchstone for the willingness of its partners to take space collaboration seriously and invest their (often scarce) resources in a project.

The demand for full disclosure in the fifth and last criterion listed above flows from this. It was also meant to ensure that the joint program did not touch directly on matters of national security at home or in the foreign country. Frutkin, as we have seen, was well aware of the tight interconnection between the civil and the military in space matters. The requirement that the results of any joint effort be disseminated as widely as was practicable was at once a gesture to this commingling and an attempt to carve out a space for the civil alongside the military. The concept of peaceful use, as I stressed earlier, helped define the limits of the civil domain because it restricted the military to the aggressive. These definitions permitted the collaborative exploitation of scientific data on, say, the effect of electric densities in the ionosphere on the propagation of radio waves, a topic of considerable interest to scientists, but also to commercial and government bodies, including the military.[63]

When Frutkin first formulated his programmatic ideals, he focused almost entirely on space science. This was because most nations could not dream of engaging in major joint technological projects with the United States at the time. The exception was the Soviet Union. Indeed, in a famous speech to the United Nations on 20 September 1963, President Kennedy suggested that there was "room for new cooperation, for further joint efforts in the regulation and exploration of space," adding that "I include among these possibilities a joint expedition to the Moon." Kennedy died before he was able to explore these proposals further, but the obstacles posed by technological exchange to any joint lunar venture were obvious to astute observers. As one editorial noted, the United States was too far ahead in design and engineering to have any interest in developing hardware with the Soviet Union. Collaboration would also undermine national security and deaden the competitive drive between, and national support for, the rival programs. It also required levels of trust between the partners that simply did not exist.[64] This is not to say that no col-

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63. I am referring here to the so-called topside sounder experiment, undertaken in collaboration with the Canadian Defence Research Telecommunications Establishment, who placed the first national satellite built outside the superpowers, Alouette-I, in orbit in September 1962 using a Thor-Agena rocket provided by NASA. For a detailed analysis of this kind of overlap, see David DeVorkin, *Science With a Vengeance: How the Military Created U.S. Space Sciences After World War II* (New York, NY: Springer-Verlag, 1993).
64. "A Lunar Proposal," *Missiles and Rockets* (14 October 1963): 52. See Frutkin, *International Collaboration*, pp. 116–117.

laboration took place between the United States and the Soviet Union in the 1960s; it happened in meteorology, for example.[65] However, as Frutkin stressed, in dealing with the Soviets, the cooperation was "arms length, in which each side carries out independently its portion of an arrangement without entering into the other's planning, design, production, operations and analysis."[66] Put succinctly, the maintenance of "clean technological and managerial interfaces," along with the demand that there be "no exchange of funds," limited the threat to American technological leadership and national security inherent in the transfer of knowledge required by technological collaboration.

The criteria developed by Frutkin necessarily limited NASA's partners to those that posed no serious security risk and who were willing to make a serious commitment to space. It is not surprising, therefore, that of 38 international cooperative spacecraft projects undertaken or agreed on between 1958 and 1983, 33 were with Western Europe. Of a total of 73 experiments with foreign Principal Investigators, 52 were with this region. Canada, Japan, and the Soviet Union, along with several developing countries, made up the balance.[67] This was quite unlike a program like Atoms for Peace, which proliferated research and some power reactors throughout the developed and developing world in the late 1950s and was driven by foreign policy and commercial concerns that had little regard for indigenous capability. This difference was deliberate: Frutkin was emphatic that space collaboration should never become a form of foreign aid, and he effectively restricted the scope of NASA's activities to industrialized or rapidly industrializing countries with a strong science and engineering base.

This also explains the insistence that collaborative experiments should be of "mutual interest" (second criterion above). How could a foreign experiment that had "a character of its own" be of some value to NASA and to American investigators? For Frutkin, it had to dovetail with the broad interests of the American program, if only to justify the expenditure of United States dollars. Thus, each cooperative project had to be "a constructive element of the total space program of the United States space agency, approved by the appropriate program officials and justifying the expenditure of funds for the US portion of the joint undertaking."[68]

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65. Angel Long, "Making Atmospheric Sciences Global: U.S.-Soviet Satellite Networking and the Development of High Technology" (paper presented at the Georgia Tech School of HTS Seminar Series), 3 November 2008.
66. Frutkin, *International Collaboration*, pp. 101–102.
67. John Logsdon, "U.S.-European Cooperation in Space Science: A 25-Year Perspective," *Science* 223, no. 4631 (6 January 1984): 11–16.
68. Ibid., 33.

Logsdon has put together some of the "constructive" contributions that international collaboration, notably with Western Europe, made between 1958 and 1983, not only to the United States space effort as such, but also to the American economy and to the pursuit of American foreign policy. His findings are summarized in table 2. This table not only shows the concrete ways in which foreign experiments were to be of "mutual interest" scientifically; it also draws attention to the economic and political benefits of space collaboration, including channeling foreign resources down avenues that would not undermine American scientific and technological leadership; creating markets; projecting a positive image of the United States abroad; and promoting foreign policy agendas, including the postwar integration of Europe.

Table 2. Benefits of NASA's international programs, adapted from Logsdon.[69]

SCIENTIFIC/TECHNICAL BENEFITS
Attracts brainpower to work on challenging research problems.
Shapes foreign programs to be compatible with the U.S. effort by encouraging others to "do it our way."
Limits foreign funds for space activities that are competitive or less compatible with the space interests of the United States.
Obtains outstanding experiments from non-U.S. investigators.
Obtains coordinated or simultaneous observations from multiple investigators.
Opens doors for U.S. scientists to participate in foreign programs.
ECONOMIC BENEFITS
Has contributed over $2 billion in cost savings and contributions to NASA's space effort.
Improves the balance of trade by creating new markets for U.S. aerospace products.
POLITICAL BENEFITS
Creates a positive image of the United States in the struggle for the minds of the scientific, technical, and official elite.
Encourages European unity by working with multinational institutions.
Reinforces the image of U.S. openness in contrast to the secrecy of the Soviet space program.
Uses space technology as a tool of diplomacy to serve broader foreign policy objectives.

These putative benefits were not always welcomed by those actually engaged in the practicalities of international collaboration. American scientists and engineers, flush with the enormous success of their own program, feared that their partners were less capable than they and might not fulfill their

69. Ibid., 13.

commitments. They balked at the additional layers of managerial complexity and the assumed added cost of international projects. As resources for NASA's space science program shrunk in the 1970s, they sometimes resented the presence of foreign payloads on NASA satellites, suspecting that they had been chosen less because of merit than because they were free to the Agency. And they noted that by encouraging foreign powers to develop space capabilities, NASA was undermining the American leadership in high-technology industry: it was producing its own competitors.[70] International collaboration was not uncontested at home, particularly as NASA's partners gained in maturity and were competitors as much as collaborators.

The weight of the several factors (scientific and technical/economic/political) that were brought into play in the first two decades of international collaboration varied depending on circumstances. A scientific experiment built with a foreign Principal Investigator and paid for by a national research council—like Geiss's Solar Wind Experiment on Apollo 11—raised few, if any, broader economic or political issues. Complex and expensive projects calling for major technological developments and managerial inputs were at the other end of the spectrum.

The 1975 Apollo-Soyuz Test Project (ASTP) is the best-known example of this. Often reduced to simply a "handshake in space," it involved docking an American Apollo and a Soviet Soyuz spacecraft with each other in orbit 120 miles above Earth. During the two days in which the hatch between Apollo and Soyuz was open, three American astronauts and two Soviet cosmonauts exchanged pleasantries and gifts and conducted a few scientific experiments together. This was above all a political statement, a concrete manifestation of the new climate of détente with the Soviet Union being pursued by President Nixon and his National Security Adviser and Secretary of State, Henry Kissinger.[71]

Political concerns also provided a trigger for two other major projects in the 1960s and 1970s. One was Helios, the $100 million venture to send two probes built in (West) Germany and weighing over 200 kilograms each to within 45 million kilometers of the Sun.[72] Helios was the most ambitious joint

70. For these objections, see Logsdon, "U.S.-European Cooperation," 13.
71. For a summary account, see Joan Johnson-Freese, *Changing Patterns of International Collaboration in Space* (Malabar, FL: Orbit Books, 1990), chap. 6; Smith, "America's International Space Activities," 19.
72. NASA's participation in the project is described in Frutkin, "International Cooperation." For the political dimension, see John Krige, "NASA as an Instrument of U.S. Foreign Policy," in *Societal Impact of Spaceflight*, ed. Steven J. Dick and Roger D. Launius (Washington, DC: NASA SP-2007-4801), pp. 207–218. See also John Logsdon, "Astronautical Research in the Transatlantic Perspective," in *Ein Jahrhundert in Flug, Luft- und Raumfahrtforschung in Deutschland, 1907–2007*, ed. Helmuth Trischler and Kai-Uwe Schrogl (Frankfurt, Germany: Campus, 2007).

project agreed to in the 1960s between NASA and a foreign partner. It was the result of an invitation for space collaboration made by President Lyndon Johnson to Chancellor Ludwig Erhard during a state banquet at the White House in December 1965. For Erhard, a major civil space project was one way of reducing German obligations to buy military equipment from the United States, as required by the offset agreements between the two countries. For Johnson, it was a gesture of support for America's most faithful ally in Europe at a time when the Vietnam War was increasingly unpopular and the French were increasingly hostile to the North Atlantic Treaty Organization (NATO). Of course, once the official offer had been made, these political concerns receded into the background (and Erhard was soon punished in domestic elections for being too "pro-American"). Scientific and technical success, however, should not be decoupled from the political will that created the essential window of opportunity for scientists, engineers, and industry to embark on such an ambitious project so early in Germany's postwar space history with NASA's help.

The same can be said of the Satellite Instructional Television Experiment (SITE), another impressive international project that was agreed to with the Indian authorities in 1970. In this experiment, an advanced application satellite (ATS-6) was first placed into geosynchronous orbit to perform some experiments for various U.S. agencies before being shifted further east.[73] From its new position, it could broadcast television programs to village receivers directly or via relay stations provided by the Indian authorities. For India, the satellite was a marvelous way of bringing educational television, produced locally and dealing with local needs like family planning, into otherwise inaccessible rural areas (programs were broadcast in eight languages directly to small receivers in over 2,000 villages), while giving an important popular boost to the indigenous space program. For the United States, it served a variety of political and economic needs. It sealed a bond with an ally deemed unreliable and promoted the modernization of India as an alternative model to China for developing countries. It was part of a broader strategy to channel Indian resources down the path of civilian technologies. And, by withdrawing the satellite from service after a year, NASA successfully encouraged the Indian government to buy additional models from United States businesses. The SITE,

73. For the NASA perspective, see Frutkin, "International Cooperation." For the broader foreign policy dimensions, see Ashok Maharaj, "Regaining Indian Prestige: The Chinese Nuclear Test, NASA and the Satellite Instructional Television Experiment (SITE)" (paper given at the SHOT Conference, Lisbon, Portugal, October 2008).

while being of undoubted benefit to various constituencies in India, also served multiple geopolitical needs for the United States in the region.

In all of three of the cases just described, while political (and economic) motives were part of the broader context inspiring the collaborations in question, they were essentially left behind or bracketed during the scientific and technical definition of the projects and their implementation. Once the programs got under way, the fundamental maxims of clean interfaces and no exchanges of funds dominated development. Perhaps the Soviets learned a good deal about how the United States managed large-scale space programs through the ASTP. However, as far as hardware is concerned, Marcia Smith remarked in 1984 that "it [was] difficult to point to a single example of new space technology being used by the Soviets that might have come from their experience with ASTP (except for the remodeling of the Soviet mission-control center to resemble the one at NASA's Johnson Space Center)."[74] Indeed, the flow of technology facilitated by cooperation of this nature should not be exaggerated: one NASA Task Force insisted in 1987 that "the major paths for Soviet acquisition of US and Western technology are espionage, evasion of export controls, and access to open literature."[75]

Similarly, there was no significant technology transfer in the Helios project. NASA provided two launch vehicles, some experiments, and the use of its deep space network. Germany designed, manufactured, and integrated the two space spacecraft, provided 7 of the 10 experiments, and operated and controlled the two satellites from a center on domestic soil. Once again, there was doubtless a transfer of managerial expertise in the joint working group that, as in all NASA cooperative projects, was involved in the technical implementation of Helios. However, it focused primarily on payload-spacecraft and spacecraft-booster interfaces, so it was not engaged in the industrial development of core hardware on either side of the Atlantic.[76] Finally, in the SITE, the United States provided the space segment (for very little cost to NASA), while India provided the ground segment.[77] I quoted Frutkin earlier as stressing that if there was political advantage to be gained from international cooperation, it should be exploited after the fact. This was possible in these cases because, by enforcing

74. Smith, "America's International Space Activities," 19.
75. Hermann Pollack, "International Relations in Space. A U.S. View," *Space Policy* 4, no. 1 (February 1988): 28.
76. Frutkin, "International Cooperation in Space," 336.
77. Ibid., 333–334.

his criteria for collaboration, NASA could draw a more or less sharp distinction between the technical and the political that mapped onto various phases of the joint ventures. The balance between the two shifted dramatically as one moved from initiation, through technical implementation, and on to operation.

There was a notable exception to this: the major initiative, inspired by NASA Administrator Tom Paine, to engage Europe at the technological core of the post-Apollo program between 1969 and 1973.[78] In a nutshell, with NASA's budget shrinking dramatically after the "golden years" of the Apollo lunar missions, Paine hoped to get Europe to contribute as much 10 percent (or $1 billion) of an ambitious program that initially included a space station and a shuttle to service it. Foreign participation would also help win the support of a reluctant Congress and President for NASA's plans. And it would undermine those who insisted that Europe needed independent access to space— Europeans were told that they were wasting valuable resources by developing their own expendable launcher to compete with a reusable shuttle that, it was claimed, would reduce the cost per kilogram into orbit by as much as a factor of 10. For several years, joint working groups invested hundreds of hours discussing a variety of projects. Some, like having European industry build parts of the orbiter wing, threw clean interfaces to the winds. Others, like the suggestion that Europe build a space tug to transfer payloads from the shuttle's low-Earth orbit to a geosynchronous orbit, a project of interest to the Air Force, touched directly on matters of national security. The entire process was reconfigured soon after President Nixon authorized the development of the Space Shuttle in January 1972. Clean interfaces and no exchange of funds imposed their own logic on the discussion (and were reinforced by anxieties about European capabilities to fulfill commitments and by fears that NASA was becoming entangled in unwieldy and costly joint management schemes). The European "contribution" was reevaluated, and Germany decided to take the lead in building Spacelab, a shirtsleeve scientific laboratory that fitted into the Shuttle's cargo bay and that satisfied all the standard criteria of international collaboration. So too did Canada's construction of the Remote Manipulator System (RMS), a robotic arm that grabbed satellites in space or lifted them from the Shuttle's payload bay prior to deployment. Once built, both Spacelab and the RMS were handed over entirely to NASA to operate.

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78. For a summary, see Logsdon, "U.S.-European Cooperation."

The debates around technological collaboration in the post-Apollo program threw into relief the limits to international cooperation in space. For the Europeans, it provided the opportunity to share cutting-edge technologies and access to desperately needed project management skills, though at the risk of not acquiring independent access to space. While many in the United States were happy to see Europeans abandon their plans for a powerful expendable launcher, they were concerned about the threat that intimate technological exchange posed to American preeminence and national security. For NASA, the question was whether the financial and domestic political benefits—as well as the enthusiasm of some sectors of U.S. industry to participate in joint ventures with leading British and European aerospace firms—were worth the risks. The decision-making process was complicated by NASA's difficulty in fixing a technical content to the post-Apollo program that would win congressional and presidential support, by Europe's hesitations, and by the multiplicity of stakeholders involved: NASA (of course), but also the State Department, DOD, and the aerospace industry, just to mention the most prominent in the United States. In the event, Germany's decision to build Spacelab (and France's to build the Ariane launcher) reaffirmed and consolidated the criteria of clean interfaces and no exchange of funds. In a single movement, all the anxieties that had accompanied technological transfer from the world's leading space power in a sensitive sector were dispensed with—though not without considerable European resentment.

The willingness to share technology in the post-Apollo program (and also in support of the European Launcher Development Organization in the mid-1960s) was part of a general sentiment in Washington, DC, that something had to be done to close the technological gap that had opened up between the two sides of the Atlantic at the time. Space technology was seen as a crucial sector for closing this gap.[79] Technological sharing would undermine European criticisms of American dominance in high-tech areas while helping to build a European aerospace industry that could eventually serve as a reliable partner sharing costs in civil and military areas: Europe would assume some of the burden for its own defense. Japan also benefited from technological sharing in the domain of rocketry (and, like Europe, was offered a stake in the post-Apollo program, which it declined). The State Department (in the person of

79. See John Krige, "Technology, Foreign Policy and International Cooperation in Space," in *Critical Issues in the History of Spaceflight*, ed. Steven J. Dick and Roger D. Launius (Washington, DC: NASA SP-2006-4702, 2006), pp. 239–262.

U. Alexis Johnson) allowed U.S. firms to transfer rocket technology to Japan in an intergovernmental agreement signed in 1969 and updated in 1976 and 1979. As Japan was forbidden to develop technologies with military potential, the performance of the subsequent N-series of rockets was deliberately constrained and no state-of-the-art technologies were transferred to Tokyo. In addition, the Japanese authorities were not permitted to provide launches for third parties without the explicit approval of the United States government.[80] There was a transfer of technology, but it was under a tight regime that enforced Japan's restricted international status as a technological power and ensured that NASA's monopoly on access to space in the non-Communist world was not yet seriously challenged.

The Changing Context in the 1980s

The context of international cooperation changed importantly in the 1980s. In essence, the technological gap between NASA and its traditional partners began to close in a variety of space sectors. At the same time, the Soviet Union began to open its closed and secretive program to international collaboration. The effective monopoly that NASA had enjoyed for two decades was over, and so was the willingness by foreign partners to accept Washington, DC's constraints on collaboration that they needed to secure access to the most dynamic, technologically advanced, and open space program on the globe.

Launchers were at the cutting edge of this transformation. On Christmas Eve 1979, the ESA successfully tested its first Ariane rocket. After overcoming the normal teething troubles, Ariane soon proved to be a spectacular success. Helped on by the lower than expected launch rate of the U.S. Space Shuttle, Arianespace (the company that commercialized Ariane) had acquired about 50 percent of the commercial market for satellites by the end 1985. A second major new player entered the field of rocketry in the late 1980s. Japan developed its H-series to replace the N-series built under American tutelage. H-I was tested in 1987. The H-2, scheduled for launch early in the 1990s, was able to reach geostationary orbit. It was, the Japanese argued, derived entirely from technology developed at home and so not subject to the restrictions that NASA had placed on the N-I, N-II, and H-I series, notably as regards providing launches for third parties. China's Long March 3 placed a satellite in geostationary orbit in April 1984; the authorities immediately announced that they were keen to

80. For a summary, see Kenneth S. Pedersen, "The Changing Face of International Space Cooperation," *Space Policy* 2, no. 2 (May 1986): 120–139.

find clients abroad. Finally, the Soviet Union was showing a greater willingness to open its previously closed and secretive launcher system for commercial use and was even seeking a contract to launch a satellite for the International Maritime Satellite Organization (INMARSAT), something that had been simply inconceivable several years before. As Ken Pedersen stressed, "It was, after all, America's launch hegemony that was the foundation of its traditional pre-eminence in cooperative enterprises."[81] That hegemony, along with the opportunities it gave the United States to dictate the terms of collaboration and to dominate the global exploitation of satellites, was now crumbling.

Launch technology was not the only area where American leadership was being challenged. Advanced communications satellites and remote sensing satellites with technologies more sophisticated than those available in the United States civil sector were being built in Europe, Japan, and Canada. The French had taken the lead in commercializing images from SPOT, an Earth remote sensing satellite that technologically outstripped the earlier NASA Landsat system, then bogged down in negotiations over privatization. Australia and a number of rapidly industrializing countries—Brazil, China, India—had constructed solid national space programs; and many third world countries, along with the Soviet Union (in a reversal of its historic policy), were clamoring for a greater say in international bodies like Intelsat, which governs the global satellite telecommunications system. In space science as well, America was becoming just one partner among others. In March 1986, an armada of spacecraft surveyed Halley's Comet on its regular 75- to 76-year sweep though the inner solar system. Giotto was the first satellite sent by the ESA into deep space, and it came within about 600 kilometers of Halley's nucleus. Other spacecraft were supplied by the Soviet Union (Vega I and Vega II) and by Japan (Suisei and Sagikake). The mission was conceived as a joint NASA/ESA venture, and although NASA cooperated by providing support through its Deep Space Tracking Network and a number of American scientists were involved in foreign experiments, the U.S. agency did not have a spacecraft of its own in the fleet. Summing up the situation, a special task force of the NASA Advisory Council reported in November 1987 "that there is in process an accelerating equalization of competence in launching capability, satellite manufacturing and management for communications, remote sensing and scientific activity, and in the prospective use of space for commercial purposes."[82] For Pedersen,

81. Pedersen, "The Changing Face," 124.
82. Pollack, "International Relations," 24.

this meant that NASA had to learn to operate in a pluralistic world in which its historic dominance was diluted along with the flexibility and freedom of action it had long enjoyed. "For NASA today," he wrote in 1986, "'power' is much more likely to mean the power to persuade than the power to prescribe."[83]

The end of the Cold War forced yet another reassessment of NASA's role. The rigidity that had marked 40 years of United States and Soviet rivalry, along with the framework for collaboration that it had defined, had now collapsed. The space program "lost an enemy." The political and military rationales for collaboration with Western allies—and the subordination of economic considerations to geostrategic concerns during the Cold War—would come back to haunt the United States: the technological gap was no more, and previous allies were now economic competitors. Most dramatically, President Reagan, the father of both the International Space Station *Freedom* and of a defensive shield in space popularly known as "Star Wars," suggested "recapitalizing" the former Soviet Commonwealth of Independent States (CIS) republics through large-scale purchases of space hardware and systems. Subsequently, "the Bush administration, in a sharp reversal of prior practice, . . . announced that it will henceforth review license applications to export dual-use technology to the CIS countries with a 'presumption of approval'."[84] The hallowed principles of no exchange of funds and clean interfaces to restrict technology transfer were being overturned. Efforts were made to retain the infrastructure and institutional memory of the major Soviet space programs in Russia and later the Ukraine, though technology transfer was restricted through the Missile Technology Control Regime. As a report for the Office of Technology Assessment pointed out in 1995, Russian industrialists involved in the ISS would be obliged to abide by Western nonproliferation rules, e.g., by not selling sensitive booster technology to unreliable partners.[85] Scientists and engineers were given strong incentives to ally themselves with United States and Western-style reforms in an effort to stem "the flow of indigenous high-risk technologies and expertise from those locations [the CIS states] to outside destinations, principally Third World Nations."[86]

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83. Pedersen, "The Changing Face," 130. See also Johnson-Freese, *Changing Patterns*, chap. 9, and Smith, "America's International Space Activities."
84. Kenneth S. Pedersen, "Thoughts on International Space Cooperation and Interests in the Post-Cold War World," *Space Policy* 8, no. 3 (1992): 208.
85. U.S. Congress, Office of Technology Assessment, *U.S.-Russian Cooperation in Space*, OTA-ISS-618 (Washington, DC: GPO, April 1995), p. 81. I thank Angel Long for bringing this report to my attention.
86. Pedersen, "Thoughts on International Space Cooperation," 216.

This change in context had palpable effects on the evolution of the plans for the ISS. NASA had already shown a new flexibility in defining this huge technological venture with representatives of the ESA, Canada, and Japan even before the President authorized the scheme in 1984; in recognition of the technological maturity of its partners and the absolute necessity to have them share the cost, NASA's "coordination in the *early planning phases* indicated a consideration of foreign partner interests and objectives unprecedented in space cooperation hitherto" (my emphases).[87] With the inclusion of Russia in the venture beginning in 1993, there was an increased move to multilateralization and interdependence. NASA and American industry could benefit directly by collaborating closely with a partner that had extensive experience in human spaceflight. It was reported in 1995 that United States firms and their counterparts in Canada, Europe, and Japan had entered into Space Station-related contracts and other agreements worth over $200 million. NASA had procured about $650 million of material from Russian suppliers over four years.[88] Russia became functionally integrated into the Station in 1998, providing critical path infrastructure elements on what became a U.S.-Russia core. America's traditional partners in Europe, including Italy, as well as Canada and Japan also made critical path contributions to the overall scheme. And in 1997, an agreement was signed with Brazil for the "design, development, operation and use of flight equipment and payloads for the international space station program."[89]

Ken Pedersen summarized the shift in NASA's policies precipitated by the rapidly changing geopolitical context of the late 1980s, and that was expressed in the collaborative arrangements for the ISS at a conference in Florence, Italy, in 1993. Pedersen began by repeating the mantra that had shaped his approach to international collaboration when he first replaced Frutkin: clean interfaces to minimize technological leakage, no exchange of funds, independent management of projects, "which was really just a somewhat nice way of saying that NASA would continue to stay in charge," and that there was "no idea of joint development of hardware. We would each do our own thing, with our

87. Eligar Sadeh, "Technical, Organizational and Political Dynamics of the International Space Station Program," *Space Policy* 20 (2004): 173. For the early history of the Station, see John M. Logsdon, *Together in Orbit: The Origins of International Participation in Space Station Freedom* (Washington, DC: Space Policy Institute, George Washington University, December 1991); Howard E. McCurdy, *The Space Station Decision: Incremental Politics and Technological Choice* (Baltimore, MD: Johns Hopkins University Press, 2007).
88. *U.S.–Russian Cooperation in Space*, p. 76.
89. Sadeh, "Technical, Organizational," 184.

own money, with our own technology and then bring it together." This was no longer the way to do business. As Pedersen put it:

> If we build long term infrastructures in space with long periods of operation, no exchange of funds is simply not going to work. If we are to build truly global space stations, we have to get used to the fact that each of us is going to be on each other's critical paths. We have to be prepared to share and jointly develop infrastructure in a way in which we must all depend on each other to get to the end of the road. We are going to have to find ways of joint decision making in which conclusions and decisions, as to both the development and operation of joint projects are made in forums in which there is genuine voting or genuine ways of expressing agreements and disagreements and reaching resolution without one actor necessarily imposing its will on another.[90]

Yet even as the physiognomy of collaboration in the Space Station was being redrawn to respond to these new principles, there were other factors at work that would undermine them, and limit their general applicability.

The 1990s and Beyond

In March 1983, President Reagan made his famous speech in which he labeled the Soviet Union an "evil empire" and suggested intercepting and destroying ballistic missiles from space before they reached American shores. "Star Wars," as it became popularly known, was never fully implemented, but it signaled a new emphasis on national security in space matters that generated considerable friction between NASA and DOD. If relationships between the two agencies previously had been relatively smooth and trouble-free, by 1987 they were "neither close nor working well."[91] The Department of Defense feared that NASA was "soft" on technology transfer and not attentive enough to national security considerations, even with its close allies. Already in 1984,

90. Ken Pedersen, "International Cooperation: Past, Present and Future," in *The Implementation of the ESA Convention: Lessons from the Past*, ed. European Centre for Space Law, proceedings of the ESA and European University Institute (EUI) International Colloquium, Florence, Italy, 25–26 October 1993 (Dordrecht, Netherlands: Martinus Nijhoff, 1994), p. 215.
91. Pollack, "International Relations," 26.

NASA Administrator James Beggs had warned his senior staff involved in the Space Station program that they were to be careful to avoid "adverse technology transfer" in international programs, notably where the Soviet Union was involved, and expressed concern about "careless and unnecessary revelation of sensitive technology to our free world competitors—sometimes to the serious detriment of this nation's vital commercial competitive position."[92] As if to confirm the point, DOD intervened in Space Station negotiations with Europe, Japan, and Canada in the mid-1980s, so undermining NASA's authority as the lead American negotiator. In short, as national security concerns (including concerns about threats to American technological and economic leadership) came to the fore in the 1980s, the fears of technological leakage threw an increasingly long shadow over civil space cooperation.

As Beggs's letter made clear, heightened concerns about technological leakage were symptomatic of the economic strength of NASA's partners, a strength that made them both valuable partners and formidable competitors. Economic concerns were now complemented by new military demands. As satellite technology became more sophisticated, the military began to appreciate the importance of space-based hardware as a "force multiplier," i.e., its capacity to enhance *traditional* military operations. Satellites began to be used to improve the effectiveness of battlefield surveillance, tactical targeting, and communications.[93] These advantages, and not the fantasies of "Star Wars," were dramatically demonstrated in Operation Desert Storm, the United Nations-sanctioned, United States-led assault on Iraqi forces that had occupied Kuwait in 1991. NASA Administrator Dan Goldin's 1993 *Final Report to the President on the U.S. Space Program* stressed this dimension of the conflict. "Control of space was essential to our ability to prosecute the war quickly, successfully, and with a minimum loss of American lives." Communications, navigation, weather reporting, reconnaissance, surveillance, remote sensing, and early warning—all these were mentioned by Goldin as essential to United States victory.[94] The defense space budget climbed in line with demand. NASA's budget remained roughly unchanged in constant dollars between 1975 and 1984 (hovering between $8 and $9 billion 1986 dollars). The defense space

92. Quoted in Sadeh, "Technical, Organizational," 174.
93. Stares, *Militarization*, pp. 242–243.
94. *Final Report to the President on the U.S. Space Program, January 1993*, submitted by NASA Administrator Dan Goldin to President H. W. Bush, 7 January 1993, available at *http://history.NASA.gov/33082.pt1.pdf* (accessed 15 December 2008).

budget came from behind to equal NASA's around 1981. By 2000, they were approximately the same at $12.5 to $13 billion current dollars. It was recently reported that in fiscal year 2008, the Pentagon's space program cost about $22 billion, almost a third more than NASA's.[95]

The attacks on American soil on 11 September 2001 accelerated demands for the protection of space as a key asset in America's defensive arsenal. We can get a sense of the outlines of the policy shift by comparing the lessons drawn by the United States administration from the two wars in the Persian Gulf. In 1993, Goldin suggested that the first engagement with Saddam Hussein showed how important it was "to develop and maintain our ability *to deny the use of space to our adversaries during a crisis in wartime*" (my emphasis).[96] Ten years later, Operation Desert Storm was followed by Operation Iraqi Freedom and the global war on terror. Even greater emphasis was placed on the need to secure space as an American military asset. In an unclassified summary of what was almost certainly a National Security Presidential Directive (NSPD) of 31 August 2006, it was stressed that "United States National Security [was] critically dependent upon space capabilities, and this dependence will grow." The document emphasized that "Freedom of action in space is as important to the United States as air power and sea power" and, while stressing that space could be used by all nations for peaceful purposes, made a point of adding that "'peaceful purposes' allow U.S. defense and intelligence-related activities in pursuit of national interests."[97] This point was developed in one of the most controversial clauses of the unclassified document that was released in October 2006:

> The United States considers space capabilities—including the ground and space segments and supporting links—vital to its national interests. Consistent with this policy, the United States will preserve its rights, capabilities, and freedom of action in space; dissuade or deter others from either impeding those rights or developing capabilities intended to do so; take those

95. Demian McLean, "Obama Moves to Counter China with Pentagon-NASA Link," *http://www.bloomberg.com*, 2 January 2009, available at *http://news.yahoo.com/s/bloomberg/20090102/pl_bloomberg/aovrno0oj41g/print* (accessed 4 January 2009).
96. *Final Report to the President on the U.S. Space Program, January 1993*, pp. 22, 31.
97. The declassified statement, which is presumably derived from NSPD 49, is available at *http://www.fas.org/irp/offdocs/nspd/space.html* (accessed 29 September 2008). The quotations are respectively from section 5, first paragraph, and section 1, second paragraph.

> actions necessary to protect its space capabilities; respond to interference; and *deny, if necessary, adversaries the use of space capabilities hostile to U.S. national interests* [my emphasis].[98]

Many commentators have noted the continuity in United States space policy from the Reagan years to the present and have insisted that the new directive simply renders more explicit what was left vague and inconclusive in previous policy statements, including those by President Clinton (i.e., there is agreement across party lines on the broad direction of United States space policy for the 21st century). At the same time, it is worth noting the difference between my italicized phrase in Goldin's report in 1993 and that in the August 2006 policy statement. The NASA Administrator suggested the need for denial in times of wartime crisis. The new policy is far broader, and uses "national interest" to justify a range of initiatives—dissuasion, deterrence, and denial—to preserve America's "rights, capabilities, and freedom of action in space." It is this all-encompassing demand that so worries America's partners, all the more so as it is coupled with a recent history of preemptive, unilateral actions by an executive that has refused to be tied down by obstructive international agreements—as reaffirmed in the August 2006 directive: "The United States will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to or use of space." In short, there is a fundamental contradiction in the making between NASA's dependence on foreign partners to pursue its international projects and the military's dependence on space technologies to protect national interests (and to secure civil society's dependence on space technology for the successful functioning of "ATMs, personal navigation, package tracking, radio services, and cell phone use").[99]

For the moment, it is not easy to get a clear picture of how far national security concerns are subverting civilian space collaboration by crippling technological exchange. In a recent assessment of trends, Alain Dupas and John Logsdon noted that President Bush had encouraged international collaboration, but only when it "would support U.S. space exploration goals." They went on to suggest that it seemed that a "unilateral approach [was] emerging as the

98. NSPD 49, section 2, item 5.
99. The last was stressed by White House spokesman Tony Snow, as reported in Suzanne Goldenberg's article, "Bush Issues Doctrine for US Control of Space," *Guardian* (19 October 2006), available at *http://www.guardian.co.uk/science/2006/oct/19/spaceexploration.usnews* (accessed 29 September 2008).

preferred U.S. path to shaping international participation."[100] In the 1960s, United States dominance was ensured by virtue of the weakness of its partners and its monopoly on access to space. Collaboration with its allies in the free world was driven as much by generosity as by the exigencies of the Cold War. In 2007, the United States once again seeks dominance, but now for political and military reasons; increasing alienation, rather than grateful admiration, is becoming the hallmark of its international relationships. The last word on this matter will be left to the ESA's Director of Science, David Southwood, who in 2007 deplored the constraints on collaboration that resulted, in his view, from the more or less indiscriminate application of International Traffic in Arms Regulations (ITAR) to any and all space technology. As Southwood put it, "It's not 'this is military space or not military'—anything to do with space is a potential military technology, therefore arms, therefore falls under ITAR." He went on to tell me that "It looks to me as if ITAR is working against the interests of the United States in that . . . . By trying to impose a hegemony, which they can't impose, they're only encouraging others to build up alternative routes to do it . . . . Those of us who want to cooperate with the United States are frustrated by the level of regulation and nonsense we're put through, and indeed the problem we face of trying to explain to people that if we really are cooperating we have to have an understanding of what something does in the partner's piece of equipment."[101] It remains to be seen if Southwood's anger is widely shared and if new presidential policies will remove some of the current obstacles to international collaboration that he has identified.

Early in January 2009, it was announced that President-elect Barack Obama would "probably tear down longstanding barriers between the U.S.'s civilian and military space programs to speed up a mission to the moon amid the prospect of a new space race with China." Pentagon funds could be used for the civilian program in a period of recession. NASA's new Ares I rocket could be scrapped in favor of using an existing military booster. NASA-Pentagon cooperation is also being encouraged to strengthen United States antisatellite technology in the light of China's recent investments in antisatellite warfare. Defense Secretary Gates, who has been kept on by Obama, has recently remarked that these and related Chinese initiatives "could threaten the United States' primary means

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100. Alain Dupas and John Logsdon, "Space Exploration Should be a Global Undertaking," *Aviation Week & Space Technology* (5 July 2004): 70.
101. David Southwood, interview by John Krige, ESA headquarters, Paris, France, 16 July 2007, NASA Historical Reference Collection, NASA History Division, NASA Headquarters, Washington, DC.

to project its power and help its allies in the Pacific: bases, air and sea assets, and the networks that support them."[102]

At the time of writing, these are merely proposals, and it is difficult to know how much store to lay by them. Yet they are entirely consistent with the general drift of United States space policy over the past 20 or 30 years, a drift that is seeing an increasing militarization of space and a radical rethinking of the relationship between the U.S. civilian and military space programs, alongside the historic determination to use space to project United States power abroad. This blurring of the civilian/military divide can eventually only change the face of NASA and the role and limits of international collaboration in the Agency's mission.

Concluding Remarks

Looking back over NASA's first 50 years, it could be argued that while the rationale for international collaboration has changed, there is an underlying continuity in NASA's ambitions. Those ambitions are driven by a quintessentially American determination to lead in the conquest of space, a determination that has been given additional social and historical traction by defining space as a new frontier to be explored and controlled. These themes appear and reappear in presidential proclamations that characterize the conquest of space as simply the next logical step in that outward dynamic push that is the "manifest destiny" of the United States and intrinsic to American identity and American exceptionalism.[103] Thus when the Shuttle *Columbia* touched down on 4 July 1982, signaling the start of a new era in space transport, President Reagan found it fit to say:

> The quest of new frontiers for the betterment of our homes and our families is a crucial part of our national character . . . . The pioneer spirit still flourishes in America. In the future, as in the past, our freedom, independence and national

102. Robert M. Gates, "A Balanced Strategy: Reprogramming the Pentagon for a New Age," *Foreign Affairs* 88, no. 1 (January/February 2009): 28–41.
103. Jacques Blamont talks provocatively of the "The Wright brothers complex," born with the flight of the *Kitty Hawk*, the conviction that Americans have been chosen by God to be the motors of all scientific and industrial progress in the modern world and that space is their privileged domain of conquest, hence their incredulity at the Soviet firsts in space and the Soviet nuclear test in August 1949; see Jacques Blamont, *Venus devoillée* (Paris, France: Odile Jacob, 1987), p. 245.

> wellbeing will be tied to new achievements, new discoveries, and pushing back frontiers.[104]

Similarly, President George H. W. Bush remarked that "Space is vitally important to our nation's future and . . . to the quality of life here on earth . . . It offers a technological frontier, creating jobs for tomorrow . . . . Space is the manifest destination of a new generation and a new century."[105] America does not choose to go into space and dominate it: it does so because that is its destiny.

Historians like Patricia Nelson Limerick have pointed out that the uncritical celebration of the frontier in remarks like these obscures the violence, failures, corruption, and the near obliteration of Native Americans that were part and parcel of the conquest of the West: hardly a congenial "mission model" for NASA. She emphasizes too that much of the mythology surrounding that conquest has been shown by historians to be downright wrong. No matter. The appeal to the frontier and to "manifest destiny" functions in such contexts not as an appeal to what we now know, but as a metaphor that "guides your decisions—it makes some alternatives seem logical and necessary, while it makes other alternatives nearly invisible."[106] The alternative rendered "invisible" here is a mode of international collaboration that dilutes United States sovereignty in the interests of "genuine" collaboration; instead all cooperation must necessarily be subordinate to the preservation of American leadership and the promotion of American interests.

When NASA was first established and was reaching for the Moon, the metaphor of the frontier, and its tight coupling with American identity and America's role in the world, energized and justified the vast expenditure required for the Apollo program. The associated assumptions of conquest and control did not particularly bother the United States' partners in the free world: their space programs were too new and the need to work with NASA was too urgent for them to see the Agency as anything other than benevolent and generous. Fifty years later the metaphor lives on as the "logical and necessary" framework for thinking about how America should conduct itself in space; its partners, now mature, are finding that framework incompatible with "genuine" cooperation.

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104. Cited by Patricia Nelson Limerick, "Imagined Frontiers: Westward Expansion and the Future of the Space Program," in *Space Policy Alternatives*, ed. Radford Byerly, Jr. (Boulder, CO: Westview Press, 1992), p. 251.
105. Quoted in Goldin's *Final Report to the President, January 1993*, p. 1.
106. Limerick, "Imagined Frontiers," p. 250.

To ask NASA to change its behavior is, however, to ask far more than that new instruments be established to shape new patterns of collaborative action. It is to ask NASA and the people, Congress, and Presidents who support it (along with American industry, which is being encouraged to capitalize on the economic and military possibilities of space) to decouple space activity from a "manifest destiny" to global expansion and the domination of new frontiers.

NASA Administrator Michael Griffin made the point explicitly in his keynote address opening the conference that celebrated NASA's 50th anniversary. "Societies which do not define, occupy and extend the frontier of human action and scientific discovery will inevitably wither and die," said Griffin. That said, NASA's most important contribution over the past half decade, Griffin added, was not simply a series of spectacular space firsts and successful scientific and technological achievements. What mattered was that NASA was "*the* entity which captures what Americans believe are the quintessential American qualities. Boldness, and the will to use it to press beyond today's limits. Leadership in great ventures"[107]—with international partners willing to dovetail their ambitions with NASA's goals. To ask NASA to rethink its global role and to move toward "genuine" interdependency with its space partners as a matter of general policy is to ask the American stakeholders in space to redefine what it means to be American.

107. Michael D. Griffin, "NASA at 50" (NASA's 50th anniversary conference, Washington, DC, 28 October 2008), chap. 1 of this volume.